Collaborating About Things: technology, theory and evaluation for real-time collaboration

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More bloody social ergonomics!

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Perspective of This Workshop

- Platforms/applications to support scientific(?) collaboration
- What I will do:
  - Focus on 'science' of collaboration
  - Review collaboration technologies in *work* environments
  - Focus on real-time 'humble' tools
  - Describe methods for evaluating tools

Objectives and Strategy

- Three goals
- Evaluate real-time collaborative technologies
    - Evaluations of technology in use
- Generalise from evaluations
- Derive design principles for collaborative technologies
- Use cognitive/communication framework and methods for evaluation

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Models of Real-Time Collaboration

- Face to face collaboration as the touchstone

- Importance of multimodality

- F2F involves speech, gaze, gesture, facial expressions

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Role of Visual Information

- Gaze, gesture, facial expressions all depend on visual information and shared frame of reference

- Visual information tells us about others' focus of attention and what they are likely to talk about
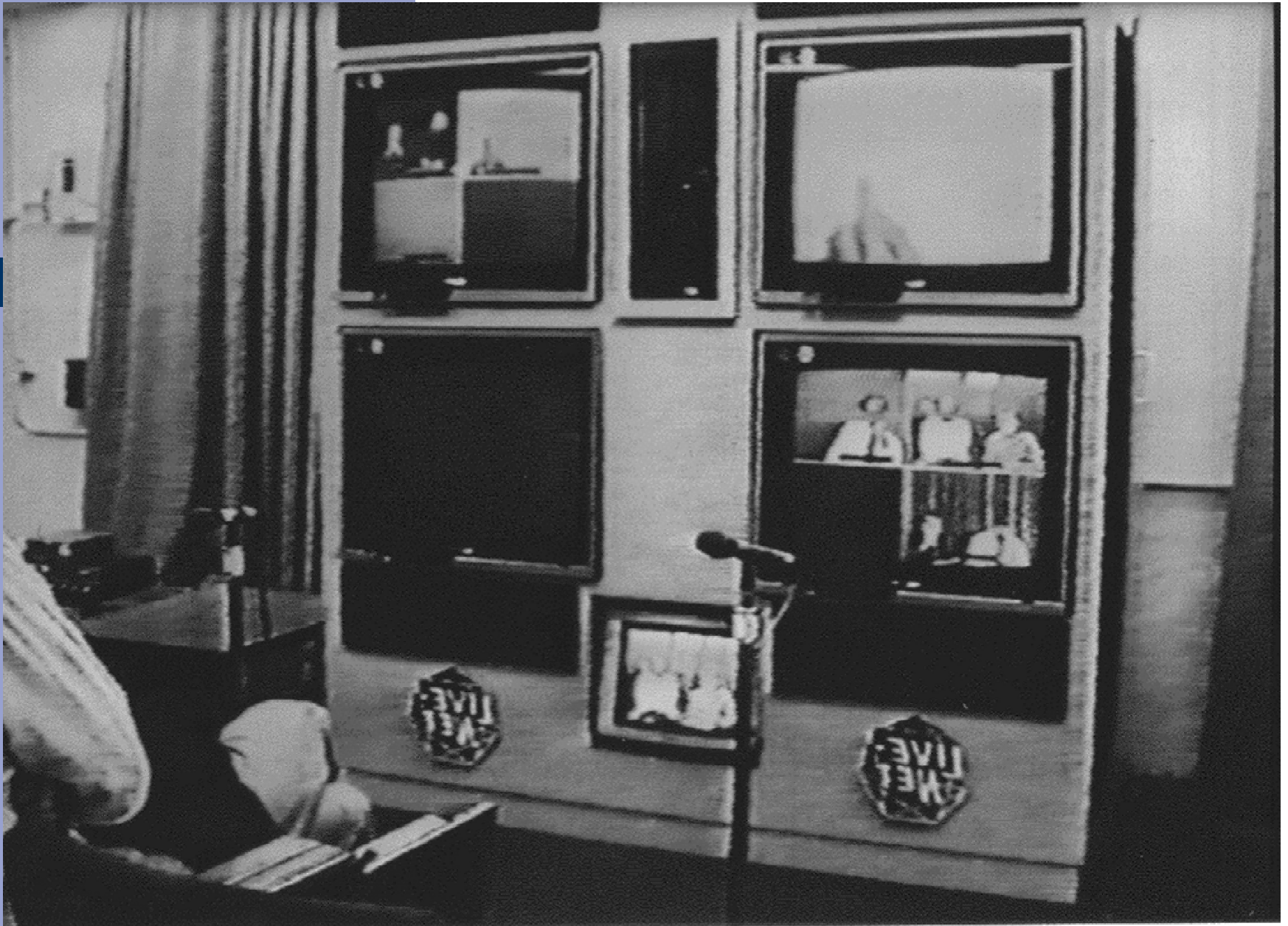
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Visual impoverishment hypothesis

- Visual mode is vital
- Implication for technology
- Multimodal technologies are superior to unimodal ones
- Videoconferencing/videophone are better than phone (speech only) or instant messenger (text only)

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Little evidence for visual impoverishment

- Visual information has little effect!!
- Compare speech with face to face or video/speech for a variety of tasks, e.g. object construction, map directions – time/success metrics
- Speech as effective as face to face or speech/video combination (Chapanis, 1972, 1977)
- So not an implementation problem
- Reid (1988) reviews 28 studies to this effect
- True for recent studies too (Sellen, 1995, Fish et al., 1992)

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Even worse – visual information may impair collaboration

- Videoconferencing systems can introduce delays into speech
- Buffer speech to synchronise with video
- Delays compromise important conversational behaviours
  - Backchannels, interruptions
  - Finely timed behaviours that demand low latency
  - (O'Conaill et al., 1993, Whittaker and O'Conaill, 1997)

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	Low quality VC	Face-to-face
backchannels/ meeting	7.00	60.80
interruptions/ meeting	1.4	18.60
completions/ turn	2.9%	7.3%
handover questions/turn	23.8%	7.7%
handover naming turn	2.7%	0.4%
turns/meeting	74.2	199.2
words/turn	62.9	31.30

Observation 1: Sufficiency of Speech

- *Visual Information is not always valuable and speech is often sufficient to support communication*

- Design Implication: Optimise overall design for high quality, low latency speech

- In our VC system we *desynchronised* speech and video so as to send low latency speech

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Visual information *is* useful sometimes

- Expression of emotional information (Short et al., 1976)
  - Facial expression, affect
  - Negotiation tasks less likely to end in deadlock when people could see each other
- Special cases
  - Non-native (Veinott et al., 1999)
  - Deaf

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Observation 2

- *Visual information is useful in a restricted set of circumstances*

- Design Implication: Add visual information if the visual channel contains unique (non-redundant) information

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What types of visual information are useful?

- I will now be more precise about when visual information is useful

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How do we design visual environments?

- What do we show?
- How do we show it?
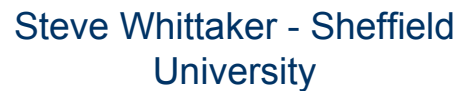
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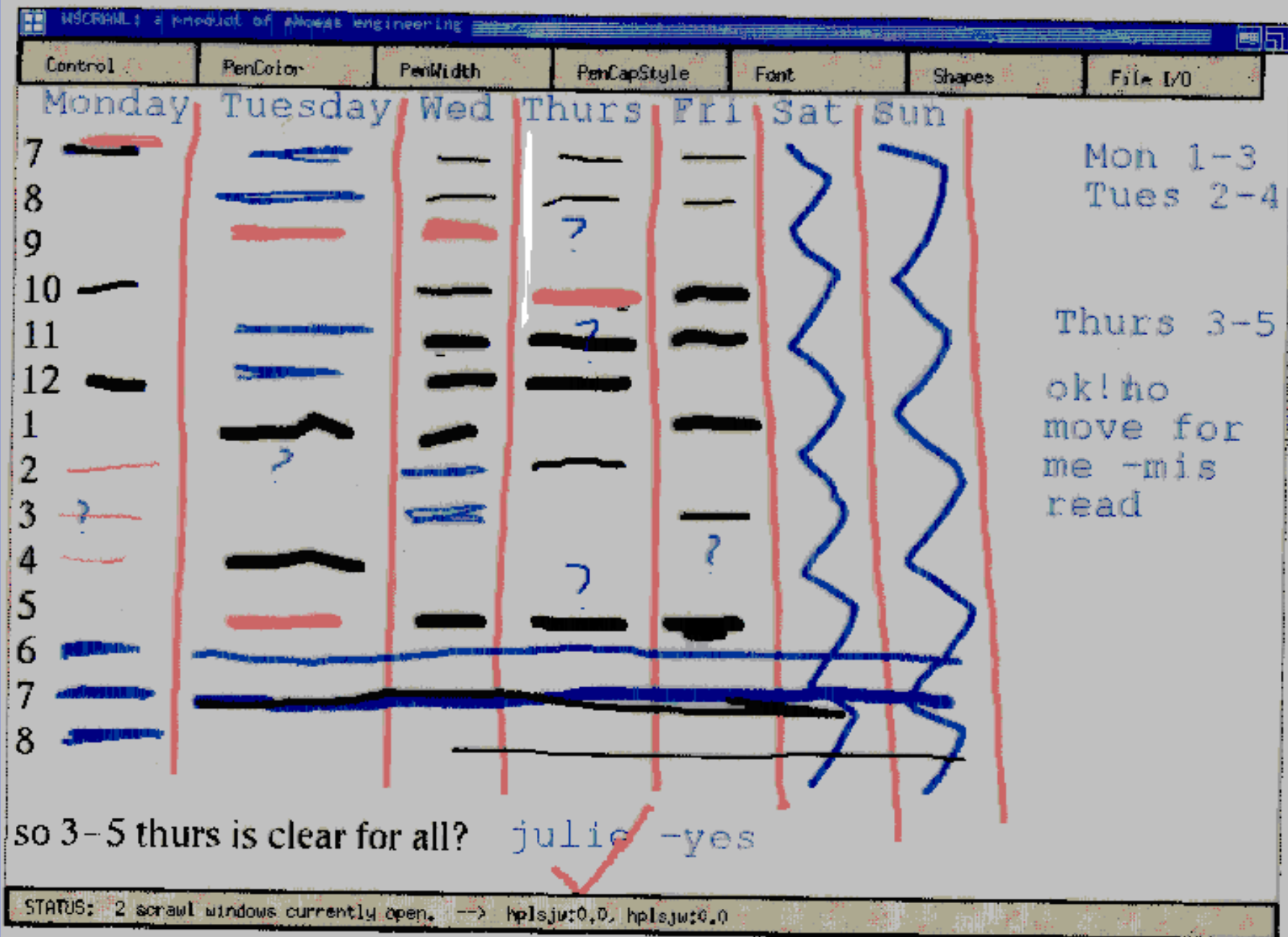
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Objects not Participants

- Videoconference, videophone show 'talking heads'
  - Generally little value to this information
- Instead show *relevant shared objects*
- Shared workspaces
  - Documents, drawings that the participants are working on
  - Allow participants to jointly modify objects and observe changes

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Seeing objects improves speech communication

- Speech only versus speech plus shared workspace

- Brainstorming, spatial design, collaborative editing tasks

- Shared workspace improves performance for most tasks

- Bly, 1988, Whittaker et al., 1991, 1993

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Shared designs

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# How does seeing objects improve speech only communication?

- Pointing gestures - 'put that there'

- Implicit communication
  - See where collaborator's attention is focused
  - Detect when they are having problems

- Tracking progress through the task

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Plan 1

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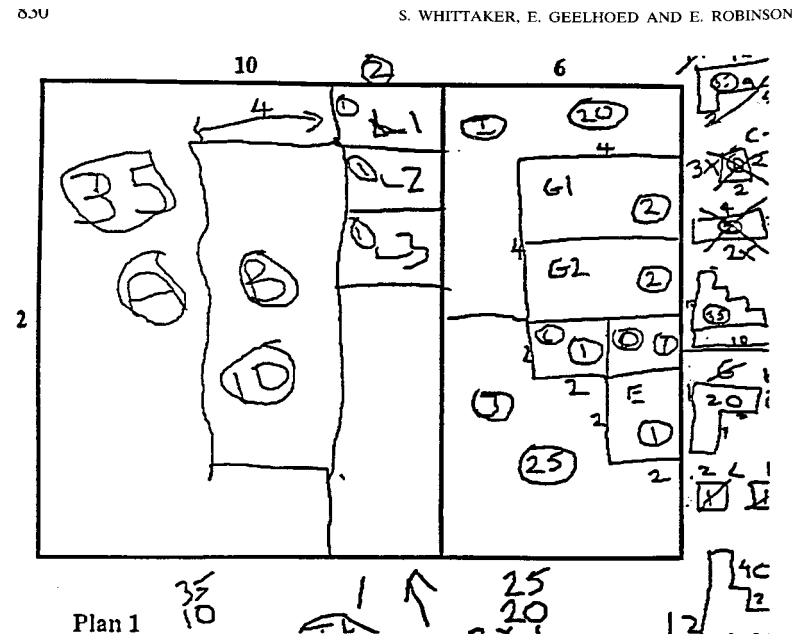
Rethinking Video – objects not participants

- Distributed surgery (Nardi, Whittaker et al., 1993)
- Operations on brain or spine

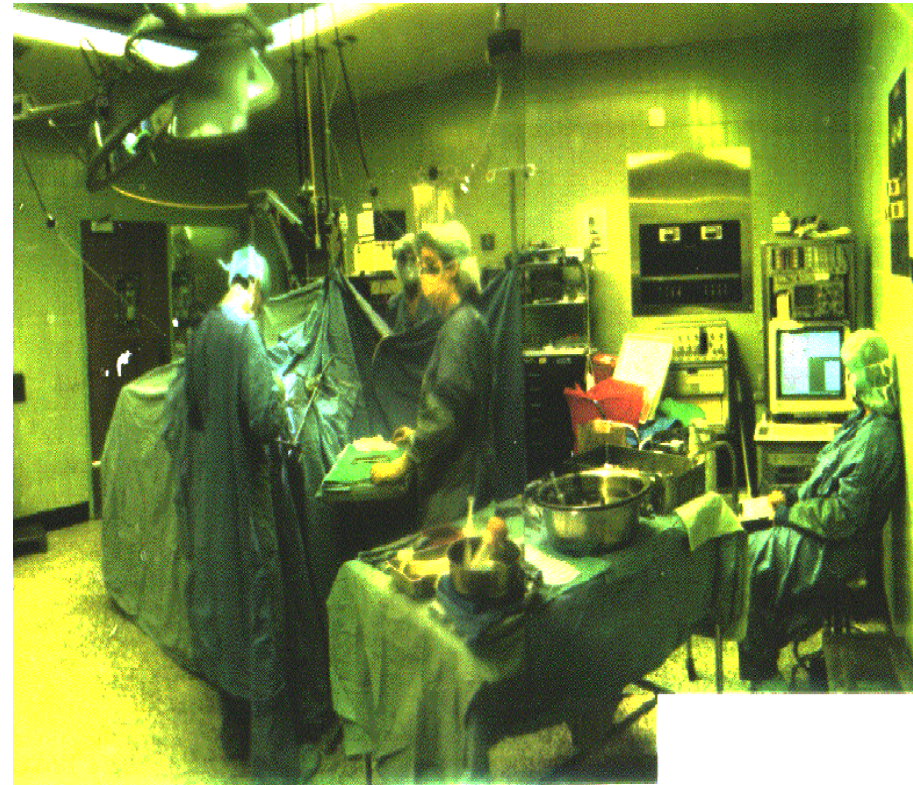Steve Whittaker - Sheffield University

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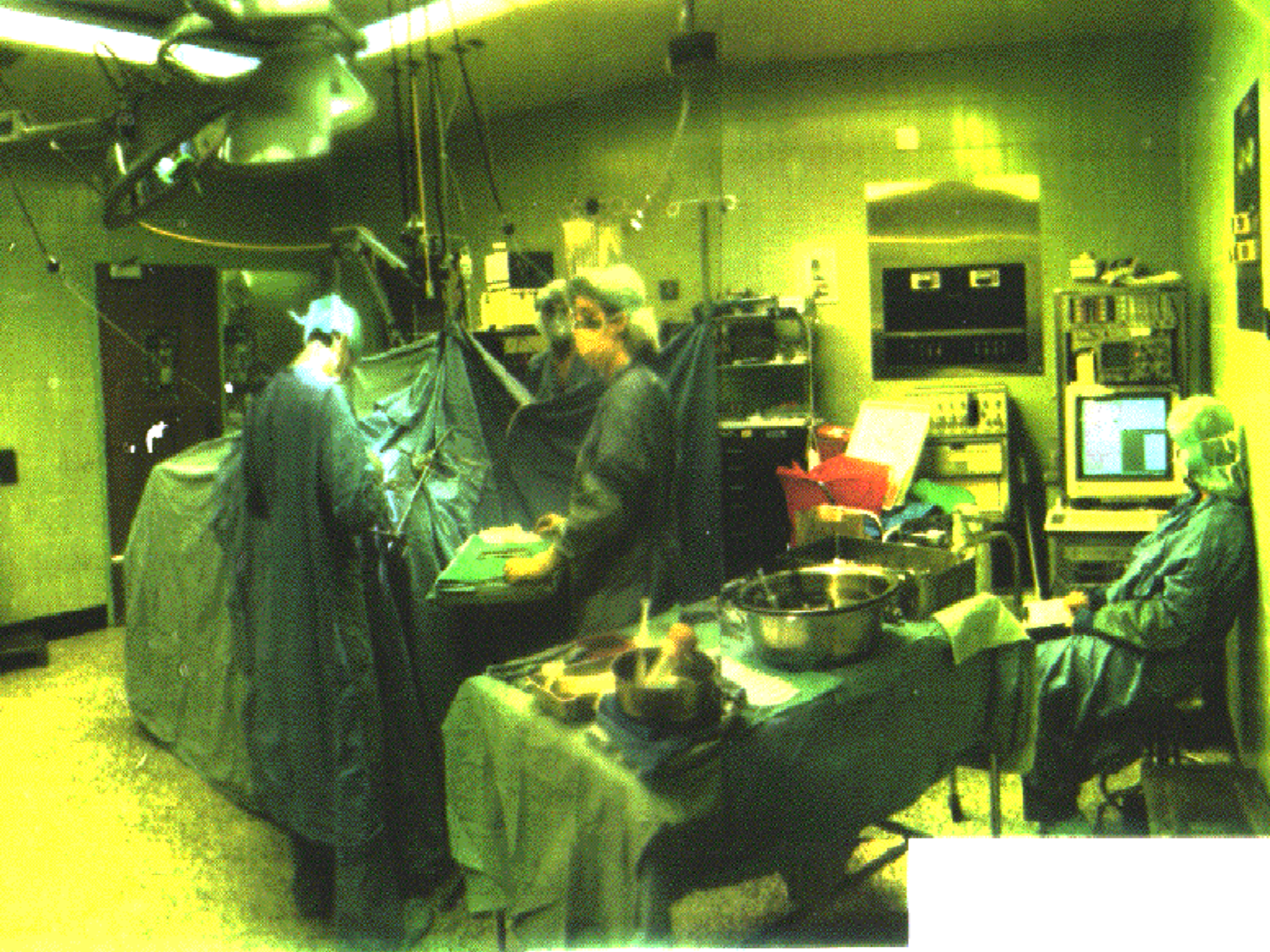
Video provides access to situational information

- Neurophysiologist monitors patient's state, but only needed for critical periods
  - 20 minutes in a 5 hour operation
  - Operation halted for expert diagnosis that requires situational information
- Operating team lack information about patient's state

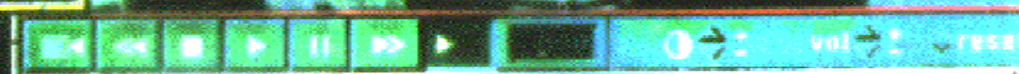Steve Whittaker - Sheffield University
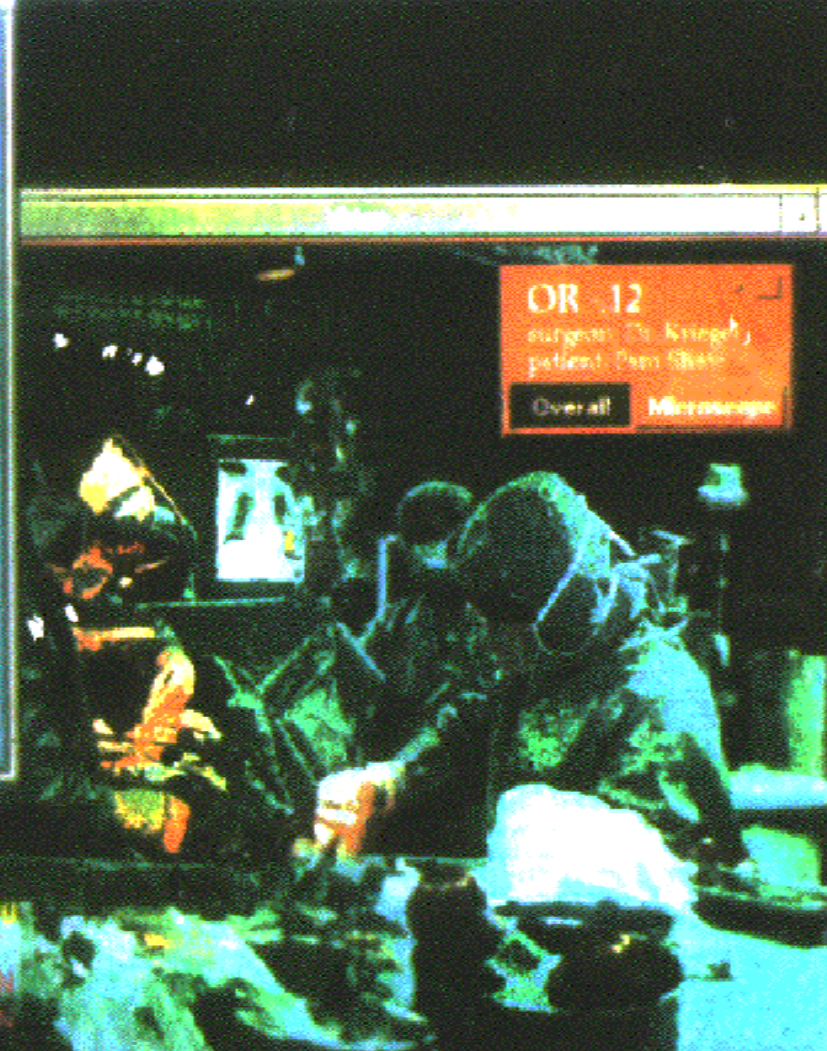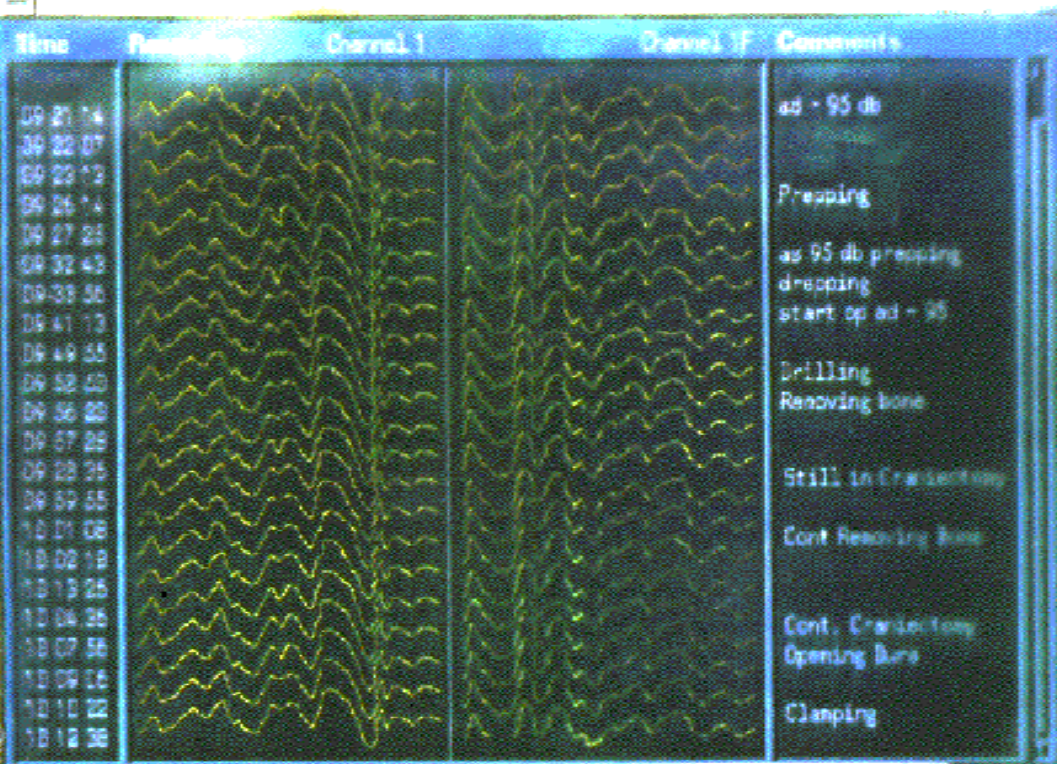
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Video provides access to situational information

- Use video to show surgeon's viewpoint – allow neurophysiologist to remotely diagnose patient's state
- Within Operating Theatre – see what the surgeon is doing
- Training

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ad - 95 db

Prepping

as 95 db prepping
dropping
start op ad - 95

Drilling
Removing bone

Still in Craniotomy

Cont Removing Bone

Cont. Craniotomy
Opening Dura

Clamping

09 21 14
09 22 07
09 23 12
09 24 17
09 27 24
09 32 43
09 39 56
09 41 13
09 49 55
09 52 32
09 56 03
09 57 29
09 59 56
10 01 08
10 02 19
10 19 26
10 04 02
10 07 56
10 09 16
10 10 22
10 12 30

Imaging

OR 12
surgeon: Dr. Kriegh,
patient: Pam Shaw

Overall Microscope

Explaining why objects work better than people

- People don't look at each other much in conversation
  - 3-7% when interesting objects present (Argyle & Graham, 1977)

- Mutual gaze is even lower (Anderson et al., 1997)

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Observation 3

- *It's better to show visual information about objects than people*
- Design Implication: show objects not people

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Shared perspectives are critical

- Exception to the value of shared objects?
- Tatar et al (1991) - few benefits for a shared workspace

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Shared perspectives are critical

- An exception?
- Tatar et al. system was designed to allow parallel work
- *Different views* on the same underlying set of objects
- Participants didn't observe changes and spent much time trying to co-ordinate perspectives
- System was laggy – slow updates created disjoint perspectives

Problems co-ordinating Perspectives

- Obtaining a shared viewed of a document in a video conference
    - 'up a bit, down a bit, left a little'
- Controls are often *local* when they should be remote
- Remote participants need to control their own views (Gaver, 1992, Whittaker & O'Conaill, 1997)

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Observation 4

- *Shared perspectives are critical: disjoint perspectives may require extra work to resolve*

- Design Implication: implement shared perspectives where possible

  - Keep versions in synch with rapid updates

  - Signal if updates have yet to occur

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Applying these principles to 'new' systems

- Sufficiency of speech
- Success story of Instant Messaging (IM)
- Linguistic (as opposed to visual information) goes a long way

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Success of IM
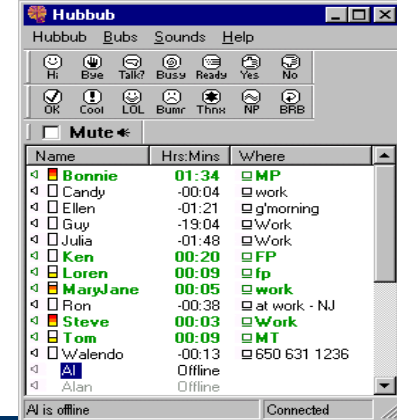
- Utility of instant messaging (IM) in supporting collaboration
- Quick questions, co-ordinating meetings
- Awareness of others
- Shared objects
- A humble application
- A communication application has been subverted for use in collaboration
- (Nardi, Whittaker and Bradner, 2000)

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Combining objects and talk

- Pre-IM system (1997)
- Talk via text
- Include applications in talk
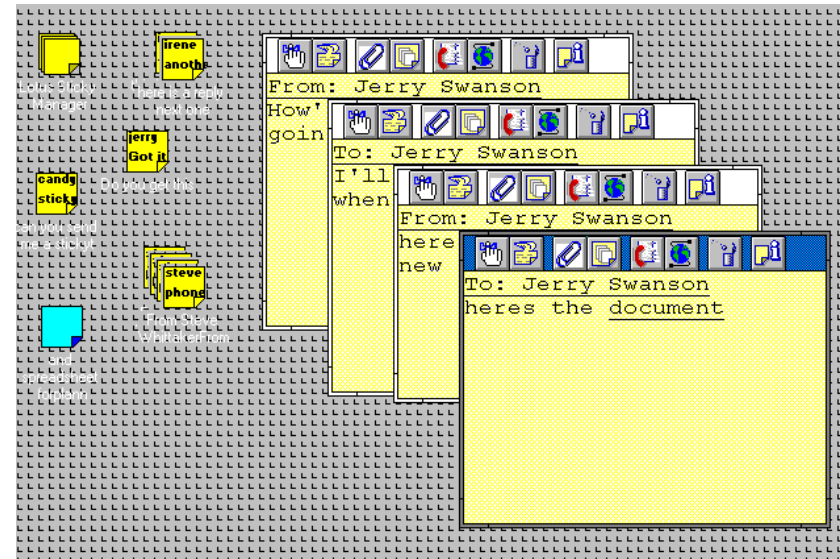
New augmented collaboration applications

- Remote avatars
- Head-mounted displays showing remote participant's perspective
- Note – these are *object not participant* focussed

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Remote avatars

- Take perspective of remote participant in environment

- Expensive expert, dangerous environment

- Laser-pointer for remote pointing

- 'Head' to show remote perspective

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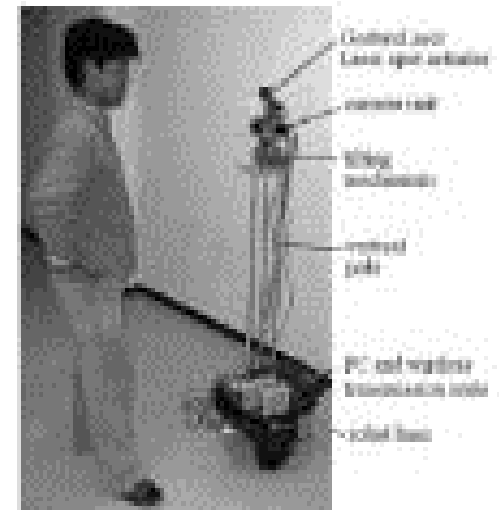
Problems in negotiating perspective

- In situ problems
- Focus of attention
  - Exactly what is the remote participant looking at?
- Field of view
  - How much can the remote participant see?
- Remote problems
  - Determining remote participants focus of attention
  - Navigating in space with a limited point of view

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Surrogate Perception

- Novice wears video headset ~miner's helmet
- Expert sees image 'through novice's eyes' (Kraut et al., 2003)
- Value to shared objects
- But not a completely shared perspective, expert can't see all of novice's visual field
- Asymmetric access – expert cant effect change

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Overall Summary

- Speech is critical

- Don't assume visuals will be useful

- Objects not people

- Ensure shared perspectives

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Outstanding issues

- Better theory of collaboration
- Common Ground (Clark), distributed cognition (Hutchins)
- Explaining the success of speech
- Better taxonomies of visual information

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Outstanding issues

- Empirical Work

- Task taxonomies – for what tasks is visual information important?

- Why aren't shared workspaces used more?

- How do people collaborate around data?

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Outstanding issues

- Design Work

- Representing Discrepant Perspectives

- Asymmetric Access

- Collaborative objects and technologies

- Object enabling communication systems
  - Shared workspaces in IM

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Questions?

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